

Master's Thesis

Design and Commissioning of a Pressure Regulator for a Nanosatellite Propulsion System

Topic



Figure 1: Beswick Engineering Piston Regulator



Figure 2: Lee IEP Solenoid Valve

Water Electrolysis Propulsion (WEP) Systems produce gaseous propellants in-orbit by decomposing stored water into Hydrogen and Oxygen using an electrolyser. This allows water to be used as a safe and green propellant, while delivering higher performance compared to conventional hydrazine propulsion systems.

The generated gaseous propellants are stored in high-pressure, compact intermediate tanks. Directly feeding these to the downstream hot- and cold-gas thrusters would result in considerable performance variation during blowdown operation and place strict requirements on downstream component selection. This can be avoided by regulating the tank pressure down to a defined constant operating pressure.

Such a pressure regulation unit must be light and compact in order to justify its implementation in a CubeSat-scale propulsion system. Previous trade-off studies identified both the use of a commercial off-the-shelf (COTS) pressure regulator and implementation of bang-bang pressure regulation using a solenoid valve as promising options.

The aim of this project is to implement and compare both options within the Ice2Thrust WEP testbench. For the bang-bang regulation, this requires the derivation of a control strategy suitable for all operating conditions, while for the COTS component a characterisation of its performance envelope is required.

Tasks

- Familiarisation with the Ice2Thrust testbench hardware and layout
- Proposal of control strategies and hardware for bang-bang pressure regulation with specified solenoid valve (Lee IEP) and pressure sensor (Kulite XTEL-140)
- Transient validation of bang-bang control strategy using 1D simulation
- Hardware implementation and commissioning of a bang-bang and COTS pressure regulator as part of the Ice2Thrust testbench
- Proposal and execution (with supervision) of test plans to validate both approaches
- Definition, and if possible, implementation of control strategy on representative flight hardware.

Deliverables

- Implemented COTS pressure regulated fluid branch
- Implemented bang-bang pressure regulated fluid branch
- Report with hardware-validated comparison of both approaches

Your Profile

- Student in Aerospace or Mechanical Engineering.
- Experience with and demonstrated interest in hardware assembly and testing is a plus.
- Experience with electrical or data acquisition hardware and software is a plus.

Contact

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